NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF THE EFFECT OF SURFACE WARFARE OFFICER CONTINUATION PAY (SWOCP) ON THE RETENTION OF QUALITY OFFICERS

by

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June 2006

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REPORT DOCUMENTATION PAGE		*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.		
1. AGENCY USE ONLY (*Leave blank*)	**2. REPORT DATE** June 2006	**3. REPORT TYPE AND DATES COVERED** Master's Thesis
4. TITLE AND SUBTITLE: An Analysis of the Effect of Surface Warfare Officer Continuation Pay (SWOCP) on the Retention of Quality Officers		**5. FUNDING NUMBERS**
6. AUTHOR(S) Jennifer L. Lorio		

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
    Naval Postgraduate School
    Monterey, CA 93943-5000
		8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.		
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.		**12b. DISTRIBUTION CODE**
13. ABSTRACT (maximum 200 words) The quality of officers serving in department head afloat billets influences the combat effectiveness of a ship. SWOCP was established to retain more quality officers in the department head ranks. This thesis addresses quality as a quantitative value that is a function of an individual's FITREPs and a time decay factor. A statistical study of the data showed no significant effect of SWOCP on the quality of officers retained. The bonus also had no significant influence on an officer's downstream performance. Based on these conclusions it appears that SWOCP has served as primarily a retention tool for quantity rather than quality.		
14. SUBJECT TERMS Surface Warfare Officer, SWOCP, Department Head, Retention, HCI, Bonus, FITREP		**15. NUMBER OF PAGES** 63
		16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

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ABSTRACT

The quality of officers serving in department head afloat billets influences the combat effectiveness of a ship. SWOCP was established to retain more quality officers in the department head ranks. This thesis addresses quality as a quantitative value that is a function of an individual's FITREPs and a time decay factor. A statistical study of the data showed no significant effect of SWOCP on the quality of officers retained. The bonus also had no significant influence on an officer's downstream performance. Based on these conclusions it appears that SWOCP has served as primarily a retention tool for quantity rather than quality.

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EXECUTIVE SUMMARY

Quality officers are needed to fill leadership billets throughout the Navy. Sea duty is considered one of the more arduous duties. As such, there is a need to ensure manning of Surface Warfare Officers (SWOs) filling department head (DH) billets afloat. In January 2000 the Surface Warfare Continuation Pay (SWOCP) was established to increase retention, alleviate manning shortages, and improve the ability to attract and retain high-quality officers in the SWO community. Quality, however, is a hard concept to measure.

The Naval Personnel Development Command created a Human Capital Index (HCI) which is said to express an individual's overall performance capability as a percentile. It is unclear, however, exactly how this index is generated. Also, the entire population of individuals in a specific rank and designator must be known to determine the HCI. This study investigates a new quantitative measure for an officer's quality using Fitness Reports (FITREPs).

Each officer FITREP contains performance traits that are averaged to create a Member Trait Average (MTA). A trend analysis of an individual's MTA over time revealed that, on average, an individual's MTA increases as he becomes more senior in a specific rank. For example, an officer who is a Lieutenant (LT) of five years generally receives a higher MTA than when he only had two years in rank.

Different reporting seniors, however, have different standards of grading an individual. In order to accurately compare officers who are graded by different reporting seniors, an adjusted MTA was calculated to account for variability among Reporting Senior Cumulative Averages (RSCUMAVG). The following equation was used to standardize an individual's MTA.

$$\text{MTA}_{\text{adjusted}} = \frac{MTA - RSCUMAVG}{5.0 - RSCUMAVG}$$

A time decay factor was introduced to place more weight on recent FITREPs, but not completely discount an officer's earlier performance. This produced a new measure

of quality called the Level of Officer Retention and Inventory Optimizer (LORIO) Score, with values ranging from -1.0 to 1.0. A Sea Score was similarly developed using only sea duty FITREPs for an officer.

Statistical analysis of the LORIO and Sea Scores for officers retained before SWOCP and since showed that SWOCP had no affect in retaining better (or worse) quality officers. The bonus also had no significant influence on an officer's downstream performance. Based on these conclusions it appears that SWOCP has served as primarily a retention tool for quantity rather than quality. Should a larger percentage of officers be retained in the future, SWOCP may be used selectively to achieve higher quality in the ranks.

I. INTRODUCTION

A. PURPOSE

The purpose of this research is to analyze the effect of Surface Warfare Officer Continuation Pay (SWOCP) on the retention of quality officers. This thesis compares the quality of retention prior to the bonus to the quality of retention under the bonus. Further, this study discusses alternate methods of offering the bonus to promote better quality in the department head ranks.

B. PROBLEM

"Retention among Surface Warfare Community department head (mid-grade) officers, typically with 6-10 years experience, has been a problem since Fiscal Year 1993." [VADM Hoewing 2005] Officers commissioned into the U.S. Navy to serve as Surface Warfare Officers (SWOs) incur a Minimum Service Requirement (MSR) of three to five years depending on the commissioning source. A junior officer's MSR is typically completed after serving as a division officer at sea (3.5-4 years) and then serving on a shore tour (~2 years), prior to serving as a department head (DH). Completion of MSR marks the first career decision point at which junior SWOs have the option to resign from active duty, remain on active duty as a SWO, or remain on active duty and "transfer laterally" to another community.

Many factors affect the decision made at this first career decision point. These factors include, but are not limited to, base pay and allowances for housing and sustenance, marital status, medical benefits, life insurance, and the civilian job market. If base pay and allowances were competitive with civilian pay scales, it might be assumed that the monetary aspect of the decision may not be a focus. SWO life, however, is arduous and with sea duty comes extended separation from family and loved ones. This is often a motivator for junior officers to leave active duty to pursue a career that will offer more stability in the quality of family life. Being in the Navy also brings with it a certain level of geographic volatility. Civilian employment may bring the allure of more geographic stability for a family.

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Many junior SWOs are released from active duty prior to serving as afloat department heads. Retention for the SWO community is typically measured at nine years of commissioned service (YCS). [VADM Hoewing 2004] In Fiscal Year 2003, retention was 31 percent, meaning that 31% of the officers commissioned into the SWO community remained on active duty in the community through nine years of commissioned service. This retention rate was sufficient to fill 90% of the approximately 275 required department head billets. An estimated 35% retention would be required to fill all necessary department head billets and the SWO community has a goal of 38% retention in order to "restore much-needed selectivity and flexibility in the distribution process." [VADM Hoewing 2005]

Money is generally a positive motivator, and SWOCP has been a contributing factor in increasing the retention rate of SWOs [VADM Hoewing 2004] The increased rate of retention, however, does not ensure that the best officers are being retained as SWOs. SWOCP is currently offered to every officer meeting the eligibility requirements, not just those who exemplify the qualities sought after by the SWO community.

An officer's quality is a hard concept to measure. While there are many attributes that define a good leader and capable mariner, there is no easy way to qualitatively compare one officer to the next. Recently, the human capital index (HCI) has been developed to attempt to place a quantitative value on the quality of performance (referred to simply as "quality" throughout the paper) of officers (as defined in Ch. IV). This measure will be explored as a means to target SWOCP to a specific type of officer.

C.   RESEARCH QUESTIONS

The SWOCP program is "designed to be an incentive, paying a Surface Warfare Officer up to a total of $50,000, to stay in the community to complete the full afloat department head requirement." [SWOCP 2000] This study researches the quality of the officers retained in the SWO community associated with SWOCP.

There are several questions this study attempts to answer regarding the effect of SWOCP.

- Is there a difference between the quality of officers retained before the bonus and after bonus implementation?

- How could the bonus be offered to attempt to increase the quality of retention?

- How can the Human Capital Index (HCI) be used as a quantitative measure of an individual's usefulness to the SWO community?

D.   SCOPE AND METHODOLOGY

This thesis includes a literature review to identify factors that have been found in the past to influence the propensity of junior officers to remain on active duty at the completion of the Minimum Service Requirement (MSR) and the effects of similar continuation pays for personnel in the U.S. military. It also examines fitness report (FITREP) and HCI data since these measures are used to evaluate quality. That evaluation then allows examination of the effect on quality of SWOCP.

This analysis uses the following steps:

- A literature review of theses, articles, and government-sponsored studies to examine existing research on bonuses and incentive pays.

- Collection and compilation of fitness report (FITREP) and human capital index (HCI) data from PERS-41 and Naval Personnel Development Command.

- Statistical analysis and presentation of alternative methods of offering incentive pay so as to maintain high quality retention.

E.   ORGANIZATION OF STUDY

Chapter I explains the purpose of this thesis and the questions that the study attempts to answer. Chapter II provides a review of previous bonus studies in the U.S. military to gain a greater understanding for how a pay incentive influences retention rates. Chapter III provides an overview of the Surface Warfare Officer Continuation Pay (SWOCP) program and the policy related to the program. Chapter IV describes the data

sources used, restrictions on the data, and provides an explanation of the data and analysis tools used. Chapter V discusses analytical results for the effect of SWOCP and opportunities for targeted offering of this incentive pay. Chapter VI summarizes the results of the statistical analysis and provides recommendations for further research.

II.   LITERATURE REVIEW

A.   INTRODUCTION

Several studies have examined the effects of bonuses and incentive pays on the retention of military personnel at critical career decision points. The majority of these studies focus on the economic cost to the military of offering a bonus and the impact of this monetary incentive on retention rates. Some other factors such as unemployment rates, military pay increases, demographics, and tour lengths have also been investigated as contributors to the decision-making process.

B.   MARINE CORPS ENLISTED

The Marine Corps Selective Reenlistment Bonus (SRB) Program can be traced back to 1965 and was designed to increase retention of Marines in certain Military Occupational Specialties (MOS). Since its inception there have been a number of payment methods. Initially the bonus was paid in annual installments; then in 1979 the payment method was changed to a lump sum upon reenlistment; and then in 1982 legislation changed the payment method to a 50% lump sum with the remainder paid in equal annual installments. Ross [2000] analyzed the effects of offering the SRB as a lump sum rather than annual payments, thus increasing the Net Present Value (NPV) of the bonus to the service member. Ross derived a personal discount rate for first-term Marines and used this assessment in Monte Carlo simulation and the Annualized Cost of Leaving (ACOL) model developed by Warner and Goldberg (1984). The analysis suggested that changing the payment method to a lump sum would increase retention of Marines by 6.8 to 11.7 percent. While there are always uncertainties in incorporating human decisions into a mathematical model, Ross asserted that while his predicted retention rates might not resemble the actual numbers; there would definitely be an increase in retention should the SRB be paid out in a lump sum. [Ross 2000] In 2000, the Marine Corps again began paying the SRB in a lump sum. Follow-on analysis by Barry [2001] concluded that "the relationship between the lump-sum payment method and reenlistment rates is positive and significant."

C.   NAVY NUCLEAR OFFICERS

Nuclear trained officers are in high demand in the Navy to fill critical billets on surface ships and submarines. The Nuclear Officer Incentive Pay (NOIP) program was enacted in 1969 to address a perceived shortage in nuclear-trained officers for submarines. In 1972 NOIP was offered to surface nuclear officers. The current program includes a continuation pay (COPAY) for officers who sign a contract to continue in the nuclear Navy. The rates are $25,000 per year for those under a four- or five-year contract and $22,000 a year for those under a three-year contract. Another part of the current program is the annual incentive bonus (AIB), which applies to officers who remain on active duty but are under no specified contract. The current rates for this bonus are $12,500 per year for unrestricted line officers and $6,000 per year for limited duty officers. In 1996 the Congressional Budget Officer conducted an analysis of NOIP to propose possible alternatives in order to minimize perceived shortages in a cost-effective manner. The study used a model developed by the Navy Personnel Research and Development Center (NPRDC) based on the multinomial logit technique. Perceived manning shortages were attributed to the non-nuclear-specific billets, which account for two-thirds of the required submariner billets and three-fourths of the required surface nuclear billets. These non-nuclear-specific billets are needed to afford nuclear officers the opportunity to develop career-enhancing skills. The model found that the Navy could retain enough nuclear trained personnel to fill 200% of all nuclear-specific billets, approximately 80% of the required submariner billets, and 60% of the required surface billets without offering any incentive pay. This led to the conclusion that "retention rates among nuclear-trained officers are relatively insensitive to the level and structure of the Navy's special pay." Further, the study concluded that targeted use of the continuation pay, such as only offering a bonus to those nuclear officers serving in critical billets, may prove more efficient for the Navy. [CBO 1996]

D.   SURFACE WARFARE OFFICERS

Nosal [1997] conducted an analysis of the proposed SWOCP using the ACOL model. At the time of the study SWOCP was proposed to be a bonus that would award $5,000 to $10,000 annually, with 50% received as a lump sum, to eligible officers

agreeing to remain on active duty as a SWO to complete two afloat department head tours. Multivariate probit models were used to predict the effects on voluntary retention rates and then the estimates from the models were used to calculate the costs and benefits of the program. The analysis was conducted on males commissioned in year groups, or cohorts, 76, 77, and 78 since their retention behavior could be followed through YCS10. The study projected that a $50,000 bonus paid out with a lump sum of $25,000 followed by $6,250 annually for four years would increase retention rates by 2.62% and create a cost-saving net benefit of approximately six million dollars for the Navy.

The 2002 study by SAG Corporation and Navy Personnel Research, Studies and Technology (NPRST) presented a behavioral model with which to predict the future impact of Surface Warfare Officer Continuation Pay (SWOCP). An ACOL model was used to estimate the dichotomous indicator of whether a person would stay in the Navy for an entire year based on a number of predictor variables including military pay, commissioning source, demographics, number of dependents, and quality of life variables. Using two years of data since the institution of SWOCP in January 2000, the model estimated an increase in the probability of retention by 15.7 percent. This, however, was an overestimate because the model treated SWOCP as "free" money void of the consideration of an additional commitment to the service member. This study also found that a rise in the unemployment rate had a positive impact on retention rates. This supports the logic that a weak civilian job market would make the job security of the military a more attractive option for junior officers.

E.   SUMMARY

Many studies have been conducted to determine significant factors that enter into the decision of a military person to remain on active duty or resign following an initial obligated service requirement. A number of these studies focus on whether or not monetary compensation will increase the retention rates of a cohort. These studies, however, focus only on the number of personnel retained and not the quality of the person retained. It is likely that the quality of retention has not been addressed since it is difficult to compare the utility of one person to that of another.

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III. SURFACE WARFARE OFFICER CONTINUATION PAY (SWOCP)

A. HISTORY OF SWOCP

Surface Warfare Officer Continuation Pay (SWOCP) was established in January 2000. It is an incentive pay intended to persuade junior officers to remain in the SWO community, with the goal of filling approximately 275 department head billets. This incentive pay came as a result of a cost-benefit analysis conducted by the SAG Corporation. [SAG Corp 1996] The possible benefits set forth by the Navy to necessitate this program were the following:

- Increase retention and reduce the number of required accessions, thereby saving money on accession and training costs;

- Alleviate near-term manning shortages of cohorts approaching department head billets;

- Improve the ability to attract and retain high-quality personnel in the SWO community.

The study focused on the expected increase in retention through YCS10 as a result of offering $5000, $10,000, or $15,000 annually for each year of obligated service. All bonus amounts showed an increase in retention and the cost savings increased with the increased level of the incentive pay. The model predicted that offering $10,000 annually would likely provide a surplus for the target endstrength, but the lesser bonus amount fell short of the manpower target. Although the $15,000 amount showed a larger cost savings than the other two, most of these savings result from the reduced number of accessions. Since the SWO community manager did not foresee accession rates dropping below 700, the conclusion was that the $10,000 annual pay would be the most cost-effective program by which to attain the desired retention rate.

B. ELIGIBILITY POLICY

The eligibility policy set forth in the SECNAV Instruction states that to apply for SWOCP an officer must be in the Regular Navy or Naval Reserve on active duty and meet the following requirements.

- Is qualified and serving as a Surface Warfare Officer (designation 111X);

- Has been selected for an assignment as a department head on a surface vessel and offered a contract by PERS-41 in conjunction with a department head or special screening board;

- Has completed any service commitment incurred by the officer's original commissioning program;

- Is able to complete the afloat department head tours or a single longer tour as assigned by PERS-41;

- Is designated to fill department head sequencing plan billets. This does not apply to officers in follow-on (third tour) billets;

- Applies prior to graduation of Department Head School. Officers will be ineligible for SWOCP if they do not apply prior to graduation. This does not apply to officers still with their Minimum Service Requirement (MSR) at graduation from Department Head School, or who were serving as department heads on 1 October 1999.

C. PAYMENT METHOD

The current structure of SWOCP allots a total of $50,000 to each participating officer to be paid out over a number of years. The first installment of $10,000 is paid to the officer upon acceptance of his application for SWOCP by PERS-41. Another installment of $10,000 is paid at the start of Department Head School or at the start of his first afloat department head tour, whichever is earliest, and that date serves as the anniversary date of the bonus. The remaining three payments of $10,000 each are paid annually on this anniversary.

IV.   DATA AND MODEL DEVELOPMENT

A.   DATA DESCRIPTION

Data about Surface Warfare officers were obtained from PERS-41, Millington, Tennessee and Naval Personnel Development Command (NPDC), Dam Neck, Virginia. The data files compiled by PERS-41 contained fitness report information for 1199 personnel from year groups 91 through 96 who had remained on active duty after the MSR to complete department head tours.. A list of current members of cohorts 90 through 92, consisting of 451 officers, was provided, as was a list of 1410 personnel who accepted SWOCP in year groups 93 through 98. Personnel data contained year group (YG), social security number (SSN), rank, designator, gender, and race.   The data compiled by NPDC contained the human capital index (HCI) for every SWO designated 111X or 116X in pay grades O-01 to O-06 for which data was available.

B.   FITNESS REPORTS (FITREPS)

Officer performance is periodically evaluated in the form of a fitness report (FITREP). The performance traits evaluated are:

- Professional expertise – Professional knowledge, proficiency, and qualifications.

- Command or organizational climate/equal opportunity – Contributing to growth and development, human worth, community.

- Military bearing/character – Appearance, conduct, physical fitness, adherence to Navy Core Values.

- Teamwork – Contributions toward team building and team results.

- Mission accomplishment and initiative – Taking initiative, planning, prioritizing, achieving mission.

- Leadership – Organizing, motivating and developing others to accomplish goals.

- Tactical performance – (Warfare qualified officers only) Basic and tactical employment of weapon systems. [BUPERSINST 1610.10A]

An officer is rated for each performance trait on an integer scale from 1.0 to 5.0, however zero represents that the trait was not observed. A score of 1.0 represents unsatisfactory or disappointing performance and implies that an officer should not be promoted until deficiencies are corrected. A score of 2.0 represents useful, promising performance, a 3.0 signifies dependable, "fully-qualified" performance and a score of 4.0 indicates advanced performance. A 5.0 for a performance trait denotes "superstar" performance and implies that the officer could also be a stand-out in the trait at a higher paygrade. Most scores for an officer should fall within the 2.0 to 4.0 range. [BUPERSINST 2005] The performance traits from a FITREP are averaged and assigned as the Member Trait Average. The reporting senior also has a cumulative average which takes into account all of the fitness reports he has written up to and including a specific report. FITREPS are typically generated annually and upon detachment of a member or his reporting senior.

Since it is necessary to maintain some significance in the FITREP data, all values were rounded to the nearest hundredth. To ease in the manipulation of these values, they were then multiplied by 100 to maintain a set of whole numbers for further calculations.

Fitness reports for individuals were first analyzed to determine if there are any apparent trends. It was believed that there may be an upward trend in an individual's fitness report as he becomes more senior within a rank. To test this theory, data was broken into lieutenant (LT) FITREPs and lieutenant commander (LCDR) FITREPs for each of the 1199 individuals in the data set, where the value of interest was the individual's average for character traits. This was further broken into three categories of LT fitness reports: Young – 0 to 2 years in rank; Medium – 2 to 4 years in rank; Old – greater than 4 years in rank. These categories were chosen because, in general, a lieutenant will spend an average of six years in rank before being promoted to lieutenant commander. LCDR fitness reports were handled similarly using the following categories: Young – 0 to 2 years in rank; Old – greater than 2 years in rank. Lieutenant commanders also generally spend six years in rank before being promoted, but the rank was only

divided into two categories because there were too few officers in the data set who had spent more than four years as a LCDR.

Trend analysis supports the suggestion that there is an upward trend in FITREPs as a member becomes more senior in a rank.
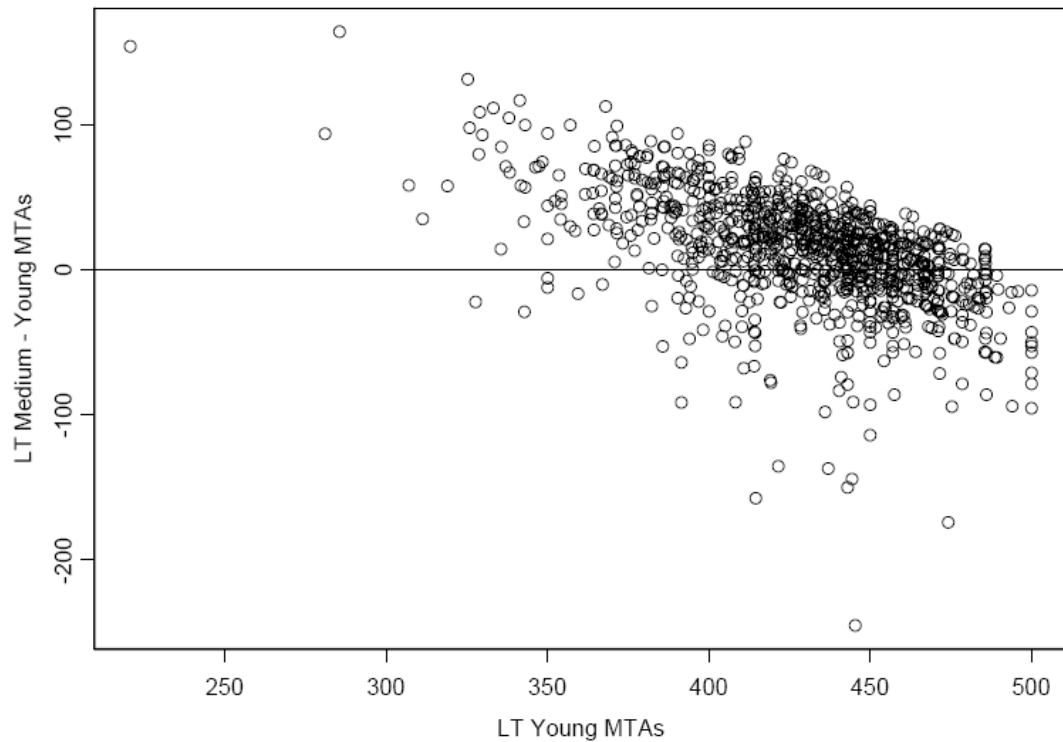

Figure 1.   LT Young to Medium Trend.

Figure 1 is a scatter plot showing the average "Young" FITREP score on the *x*-axis versus the difference between "Medium" and "Young" on the *y*-axis. Points above the horizontal line at $y = 0$ show LT's whose overall average FITREP score increased between their first two and second two years. A large cluster of points is visible above the line. Approximately 64% of the observations showed FITREPs that were higher as a LT became more senior in rank. It is also apparent that if a LT's Young FITREPs average 500, there is no way to have an increase. Figure 2 shows that the set of "Medium" – "Young" differences is not Normally distributed, but rather there are more observation to right of zero, which supports the intuition that an individual, on average, receives higher

marks as he becomes more senior in rank. The median increase in LT FITREPs from Young to Medium is 2.9% with an average increase of 2.4%.
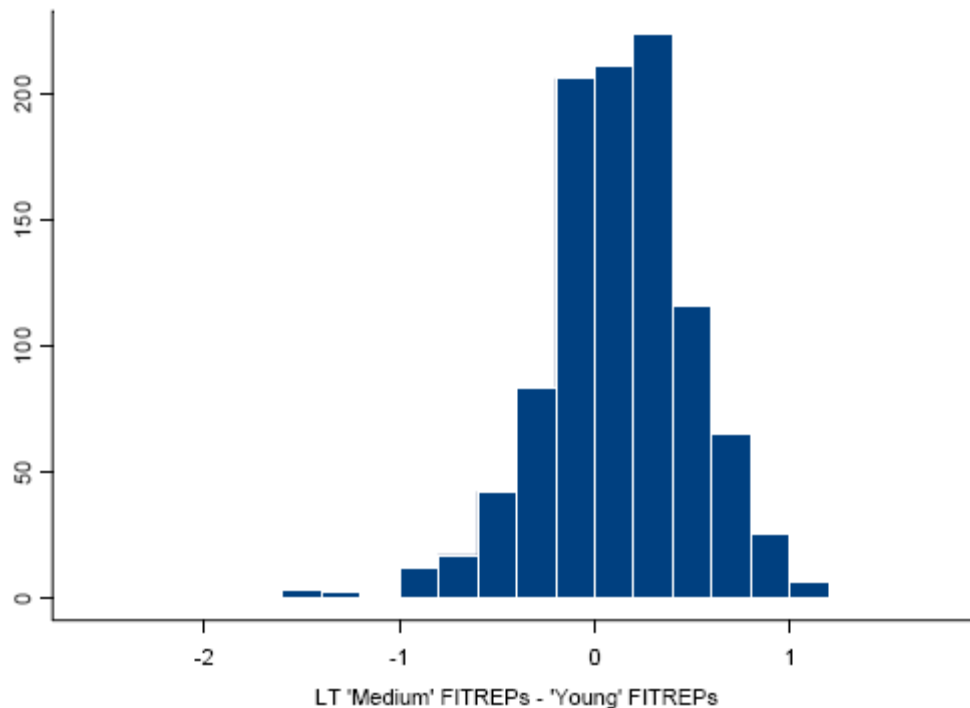

Figure 2.   Difference Between Young and Medium LT FITREPs.

Since it is now obvious that Medium FITREPs tend to be higher than Young ones, it is necessary to determine if there is an individual trend that can be recognized. The FITREP data was broken into deciles, where the first decile represents the lowest Member Trait Averages and the tenth decile represents the highest Member Trait Averages. Figure 3 shows the first and tenth deciles of Young FITREPs, with the columns depicting which decile contains those individuals' Medium FITREPs. Approximately one third of those individuals who had Young FITREPS that fell into the first decile of all Young FITREPs also fell into the first decile of all Medium FITREPs. Similarly, approximately one quarter of the individuals who were in the tenth decile as a Young LT were also in the tenth decile as a Medium LT.
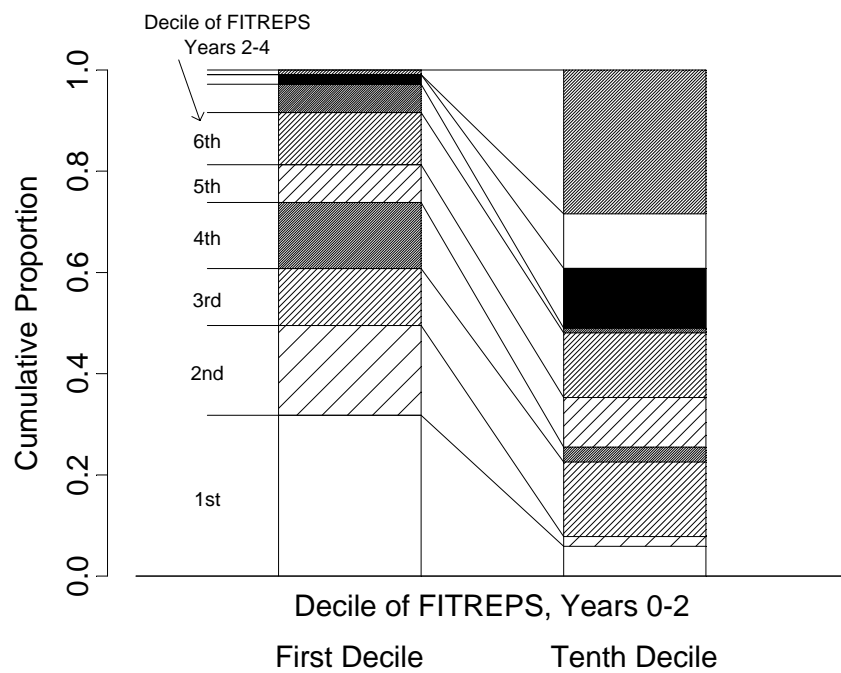
Figure 3.   Cumulative Proportion of Medium FITREPS for First and Tenth Decile Young LT FITREPs.
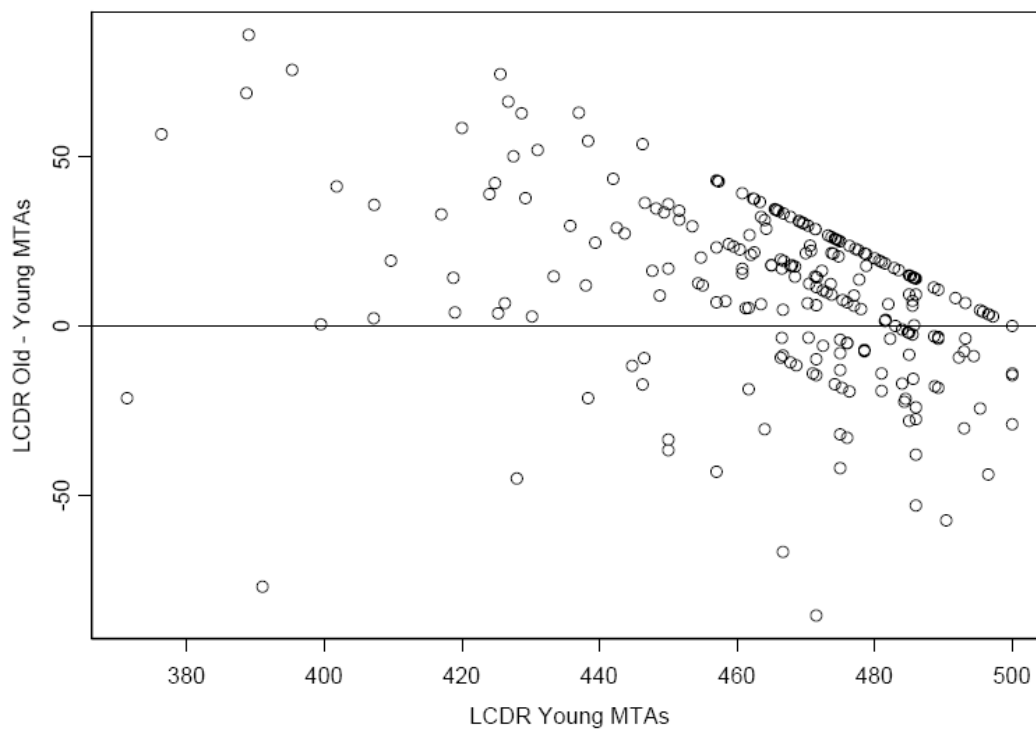

Figure 4.   LCDR Young to Old Trend.

The scatter plot in Figure 4 shows an increasing trend in LCDR FITREPs from Young to Old. Approximately 68% of the LCDR observations have higher Old FITREPs than Young. There are also some bands apparent in the data. These bands appear when certain scores are common in the Old data. The top band in the picture corresponds to those LCDR's who score 500 on Old FITREPS; the next corresponds to a score of 483. Figure 5 also shows the apparent upward trend as evidenced by the greater number of observations to the right of zero in the histogram. The median increase in LCDR FITREPs from Young to Old is 2.5% with an average increase of 2%.
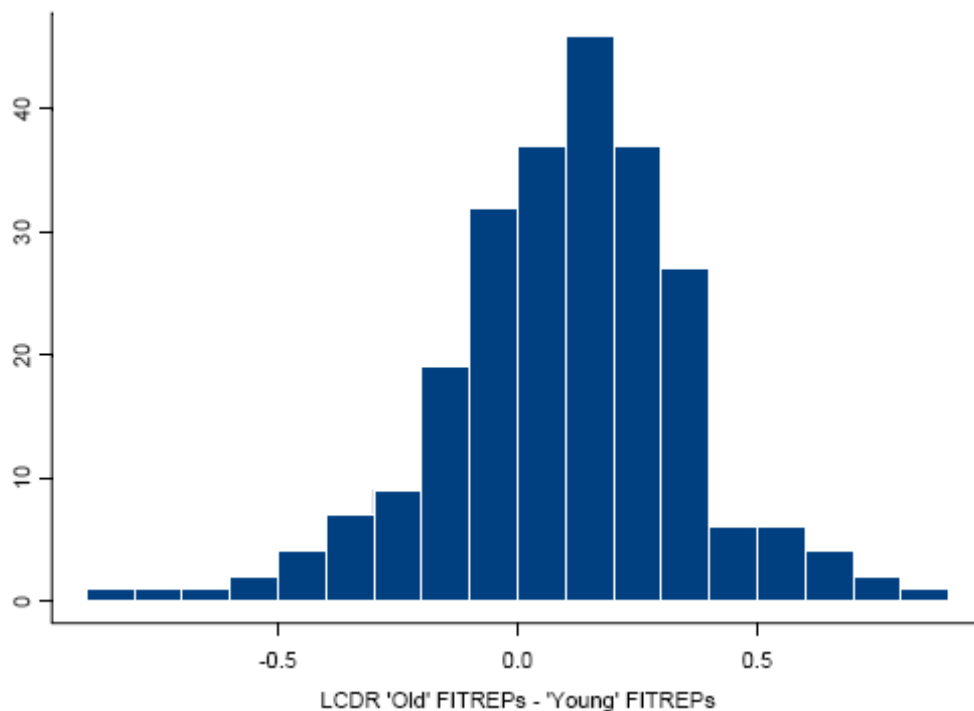

Figure 5.   Difference Between Old and Young LCDR FITREPs.

Individual trends in LCDR FITREPs are shown in Figure 6. Of the 748 observations with LCDR FITREPs, only 241 had both Young and Old FITREPs. The data set contained 41 observations with a 500 average for Young FITREPs and 67 averaged 500 for Old FITREPs. As a result of the large number of observations with 500 for Old FITREPs, deciles eight through ten are combined into one large group. Forty-three percent of the individuals who were in the first decile as Young LCDRs remained in the first decile as Old LCDRs. Similarly, 53% of the individuals who were in the eighth through tenth deciles as Young LCDRs remained in this group as Old LCDRs. This

shows that there is a propensity for LCDRs to perform at the same relative level as they become more senior rather than performing at a higher or lower level relative to others in the sample.
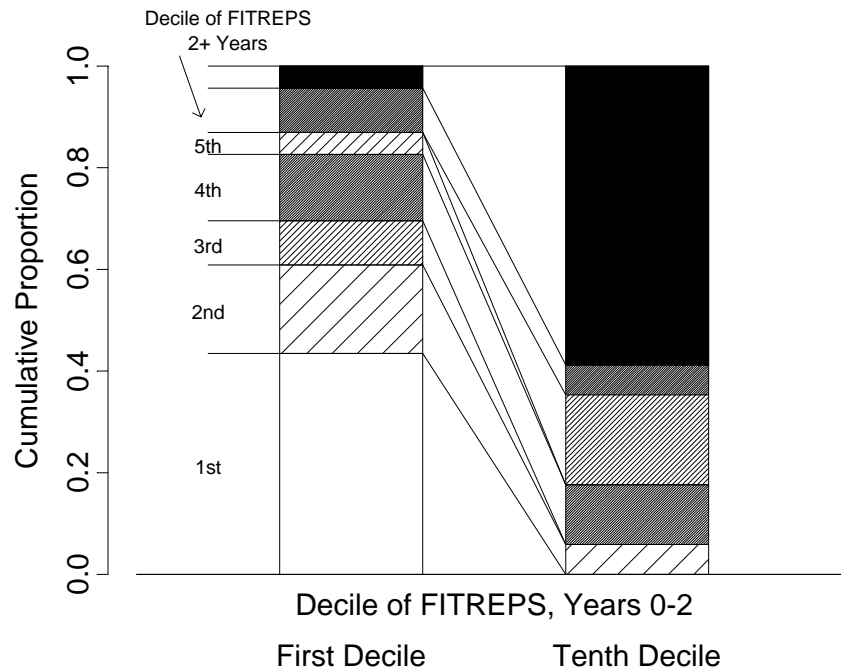

Figure 6.   Cumulative Proportion of Old FITREPS for First and Tenth Decile Young LCDR FITREPs.

C.   HUMAN CAPITAL INDEX (HCI)

The Human Capital Index (HCI) is a standardized and normalized summary score that represents an individual's overall performance capability expressed as a percentile. [HCI 2006]   This provides an index value that compares an individual to other individuals in the same occupation and pay grade.   An HCI has been computed for approximately 95% of the personnel in the Navy. The HCI was developed to become the cornerstone performance measure on the Performance Vector of the 5-Vector Model (5VM).   The 5VM is the model currently in use by the Navy to exemplify a holistic approach to developing Sailors personally and professionally. The following is a brief explanation of the five vectors included in the model. [5VM 2006]

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- Professional Development – current status and future requirements in primary rating or community

- Personal Development – lifelong learning; health, wellness, and recreation; life skills; financial management skills; interpersonal skills; and values

- Leadership

- Certifications and Qualifications

- Performance

The HCI was designed to (a) provide a fairer comparison of performance history and potential for all rates and pay grades, (b) facilitate conducting effective Human Performance Feedback and Development (HPFD) sessions, and (c) improve promotion and advancement decision-making for the Navy. [HCI 2006]

The Member Trait Average is standardized and normalized for all individuals in the same rank and designator to create a member's HCI ranging from 0.00 to 100.00, where the higher number represents better quality. Figure 6 shows a histogram of HCI values for personnel who accepted SWOCP from YG93-98. The HCI scores range from .12 to 100, with a median of 65.73 and an average of 65.14.
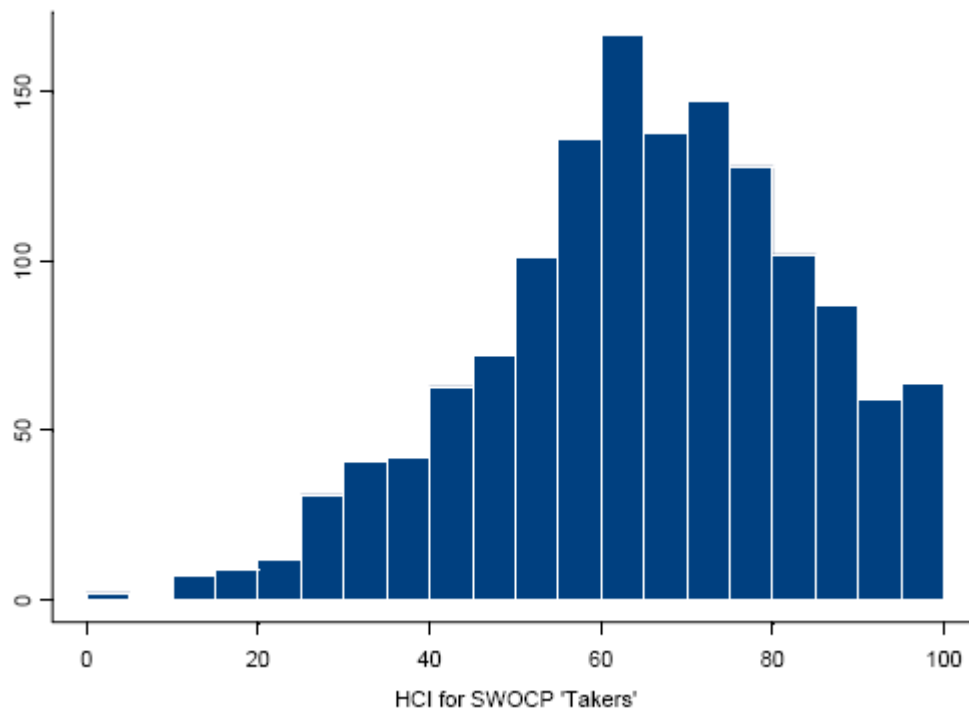
Figure 7.   HCI Scores for SWOCP 'Takers'.

D.   CONCEPTUAL FRAMEWORK

The focus of this analysis is to determine if there is a significant difference in the retention of quality officers who remain on active duty as a result of SWOCP, compared to those who remained without a bonus. While SWOCP was designed largely to alleviate shortages among the department head ranks, another goal of the program was to attract and retain high-quality personnel. Quality in these terms refers to the professional abilities of an officer.

This study uses data from year groups 90 through 98 and is limited to personnel who were retained in the SWO community after their initial MSR. Year groups 90 through 92 were not offered any bonus, whereas year groups 93 through 98 were offered SWOCP. It is assumed that if a person in YG93 through YG98 was retained in the SWO community, SWOCP was received by the individual. These are the two sets of data of interest for this analysis. Fitness reports and HCI data was available for YG 91-96, therefore these are the observations that the majority of the analysis is focused on.

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For the purposes of this study, every officer is assumed to have been commissioned on June first of his year group. While it is acknowledged that officers are actually commissioned throughout the year, this assumption was used as a baseline for a year group since actual commissioning dates were not available.

Since an officer has to apply for and accept SWOCP before he graduates from DH school, and for timing purposes an officer needs to be in DH school at the 7.5 YCS mark, it is reasonable to assume that every officer will have made the decision to accept or decline SWOCP by 8 YCS. The decision point for retention, however, is viewed as 4 years, which often coincides with an individual's MSR. On the other hand, an officer can serve on shore duty and decide to stay in or get out at any time prior to accepting SWOCP. With that, in the Division Officer Sequencing Plan used for these cohorts, an officer will most likely finish his shore tour around YCS7. Using this information and keeping in mind that it takes approximately 6 months for resignation to be processed, it is reasonable to use 6 years commissioned service as the point at which to evaluate the quality of an officer for retention purposes.

E. STATISTICAL MODEL

1. Member Trait Average

After determining the decision point and compiling the available FITREPs, there were on average six FITREPs per person to be analyzed, with 98% of the individuals having at least one. There were a few individuals who had as many as 13 FITREPs in the six year period.

A simple analysis of the Member Trait Average (MTA) and the Reporting Senior Cumulative Average (RSCUMAVG) was conducted. The following histogram of the 1180 individuals who had at least one FITREP is tri-modal, with a number of individuals who never exceed the RSCUMAVG, a number who always exceed the RSCUMAVG, and a number who exceed 50% of the time and fall short 50% of the time. The vertical lines show the 1/3, 1/3, 1/3 distribution of the proportion of time an individual's Member Trait Average exceeds the RSCUMAVG.
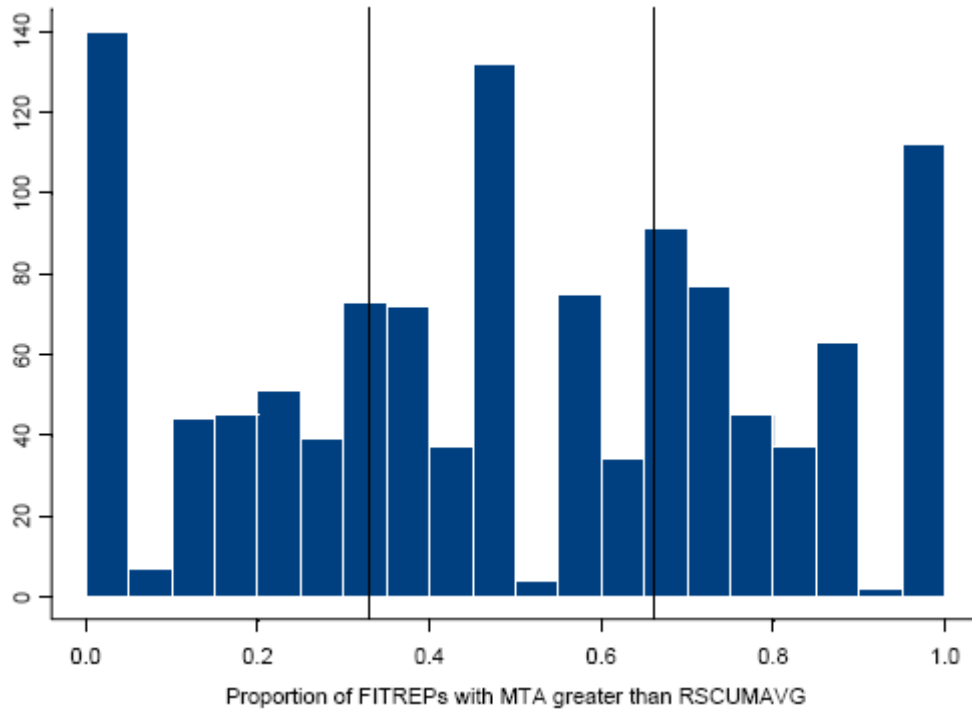
Figure 8.   Proportion of FITREPs with MTA Greater than RSCUMAVG.

2.   Level of Officer Retention and Inventory Optimizer (LORIO) Score

The algorithm for computing HCI was not made available, nor would it have been extremely useful since it operates on the entire population of personnel in a specific designator and rank. Also, an HCI is cumulative over all time, but for the purposes of determining whether or not the best quality officers are being retained, it is necessary to develop a criterion based on the years up to the decision point, in this case 6 years. Therefore, it was necessary to develop another tool for measuring quality.

FITREP data from the first six years of an officer's career was used to create an HCI-like index. In other words, since the entire data set is more than six years from commissioning date, this index will be used to rank individuals at a common point in their career, regardless of commissioning year group. The variables used to create this index include the Member Trait Average, the Reporting Senior Cumulative Average, and a time decay factor. The MTA is the only strictly quantitative expression of performance that exists for an individual. The RSCUMAVG is used as a baseline to determine the

"goodness" or "badness" of an MTA. A time decay factor is used to weight more recent FITREPS more heavily.

Two main approaches with regard to the MTA and RSCUMAVG are explored, namely taking the difference of the two quantities and using the ratio of the quantities. Each of these methods produce a vaguely symmetric histogram of values (see figures 9 and 10). Since neither of the two methods appears to offer more insight than the other, the difference will be used for all further analysis. The difference will, of course, be negative when the member's MTA is lower than the corresponding RSCUMAVG.
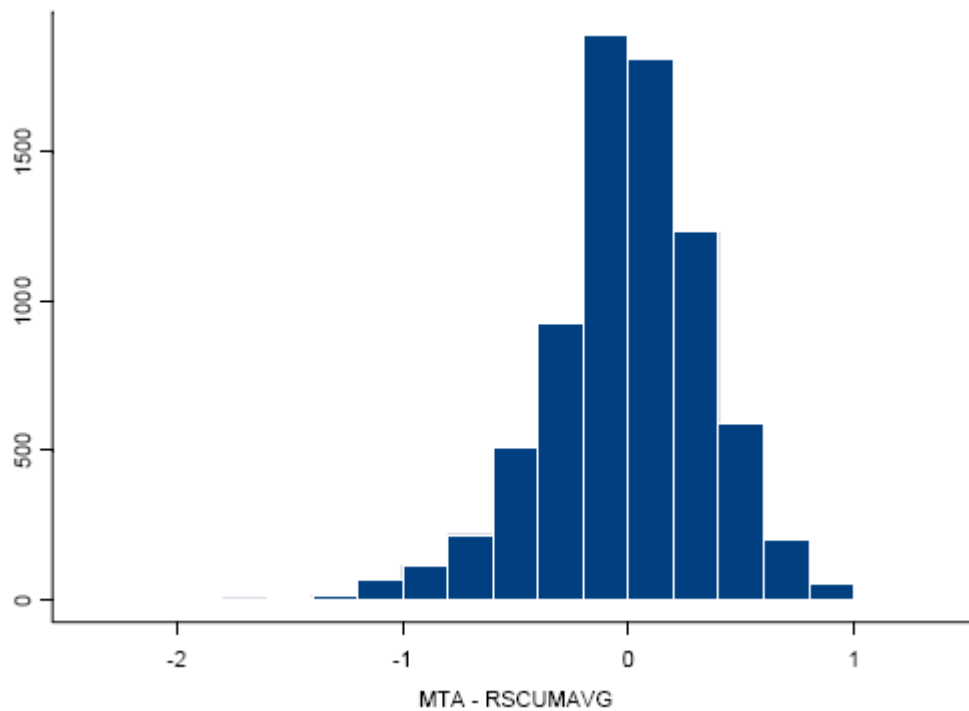

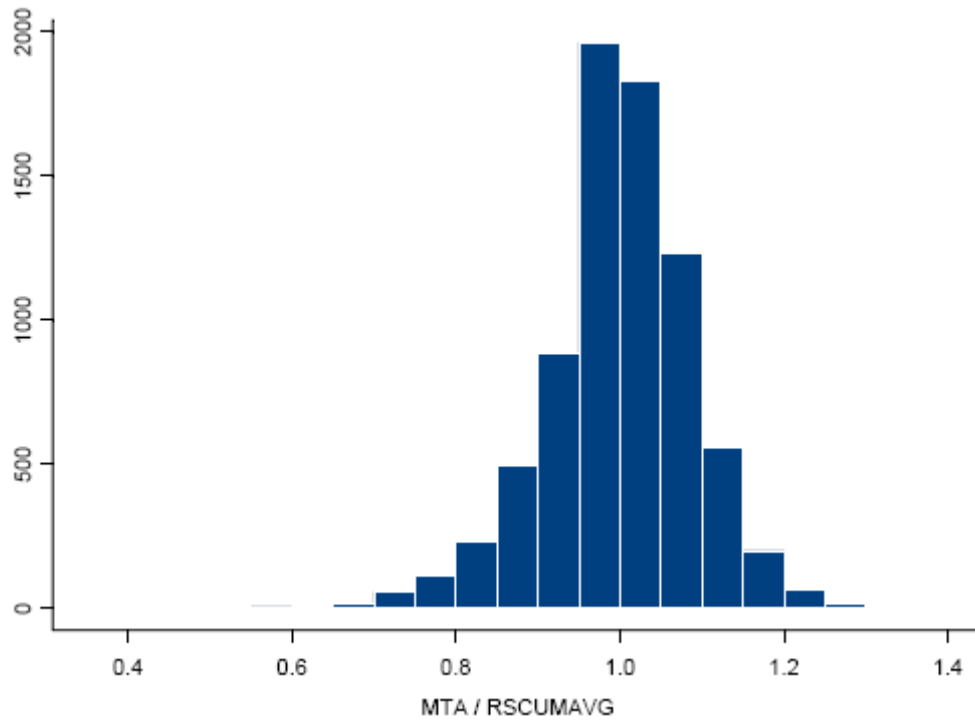Figure 9.   Difference Between MTA and RSCUMAVG.

Figure 10.   Ratio of MTA to RSCUMAVG.

Because there does not appear to be any consistency in RSCUMAVG, there was a necessity to devise a way to account for the variability. RSCUMAVGs are variable, so to adjust for that variability the difference between MTA and RSCUMAVG was scaled by the difference between the maximum possible trait average and the observed RSCUMAVG. That is, the following conversion equation was used:

$$\text{MTA}_{\text{adjusted}} = \frac{MTA - RSCUMAVG}{500 - RSCUMAVG}$$

The object of this conversion is to replace a raw MTA score by a proportion that indicates how far away an individual's score is from his or her RSCUMAVG. A score of 1.0 indicates that an individual has been awarded a score of 500, which is as far above the RSCUMAVG as possible. The distance from the RSCUMAVG to 500 shows the range, upward from the RSCUMAVG, of possible scores, and that same distance was taken as the downward range. Therefore a score of -1 indicates an MTA score that is as far below the RSCUMAVG as 500 is above it; this is taken to be the worst possible score.

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The conversion yielded values ranging from -6.53 to 1.0. The 33 observations for which RSCUMAVG was 500 were converted to 1.0. The 275 observations that were below -1.0 were assigned a value of -1.0. For example, if a reporting senior has a cumulative average of 400 out of 500, then the interval of interest for this reporting senior is [300,500]. Applying this method ensures that 500 is included in every interval, but the lower bound of the interval varies with each different RSCUMAVG. If an individual under this reporting senior is assigned an MTA of 450, then his $MTA_{adjusted}$ would be 0.5. Similarly, if the individual received an MTA of 350, the $MTA_{adjusted}$ would be -0.5.

The remaining data set contained 7620 FITREPs, representing 1180 individuals. The noticeable spikes at the extremes and in the middle of the graph are a result of the frequency of scores -1.0, 0.0, and 1.0, consisting of 288, 452, and 209 observations, respectively.
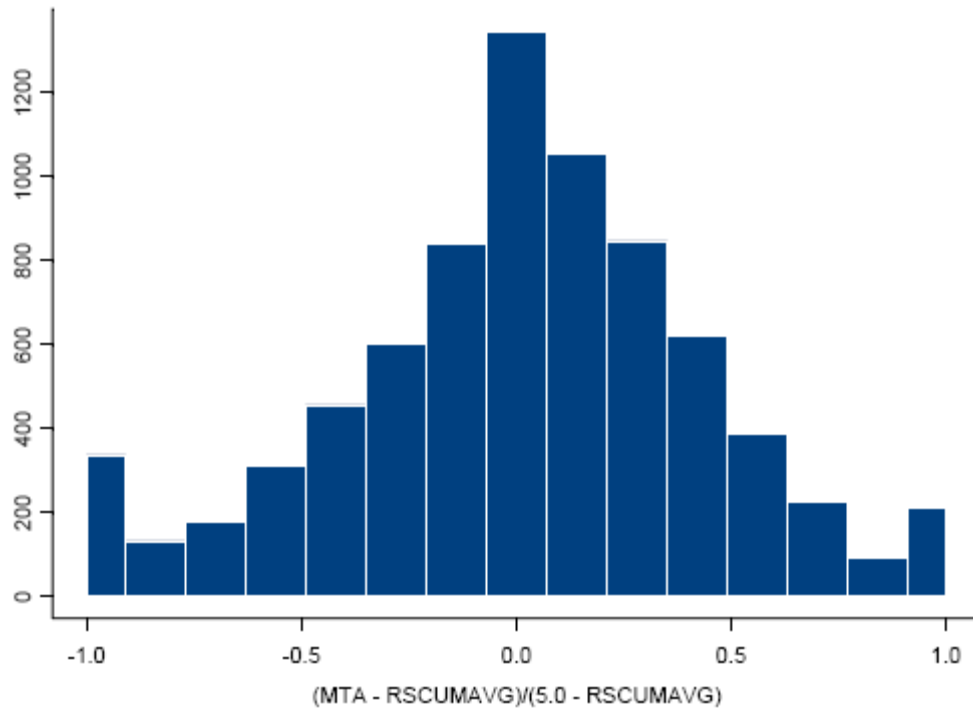

Figure 11.   Un-Weighted Ratios for Index.

The time in days that a FITREP remains an integral element in the calculation for an index is determined by the decay time, α. A typical shore tour for a junior SWO lasts two years, following time at sea. Since it is important to also take into account time at

sea, a FITREP should remain an integral part of the equation for four years, or 1461 days, and then decay exponentially. In other words, the most recent four years of FITREPs will be weighted 1.0 and those marks older than 1461 days will be given a weight equal to $\exp(-\alpha * (x - 1461))$, where x is the number of days from the end date on the most recent report to the report of interest. This factor will be used to place more emphasis on recent FITREPs so that a person who made a mistake as an Ensign will have the opportunity to recover from that issue and not continue to be "punished" throughout his or her career. Alpha was chosen to be 1/365, meaning that if a FITREP is five years old then it would be given a weight of 0.37.

For each of the 1180 members in the sample size, a weighted average of the index ranging from -1.0 to 1.0 was produced. This new value, henceforth called the Level of Officer Retention and Inventory Optimizer (LORIO) Score (LS), indicates the weighted average proportion by which a member's trait average is above or below a reporting senior's cumulative average. A histogram of the resulting values is shown in Figure 12. The LS has a mean value of 0.013 and a median of 0.019.
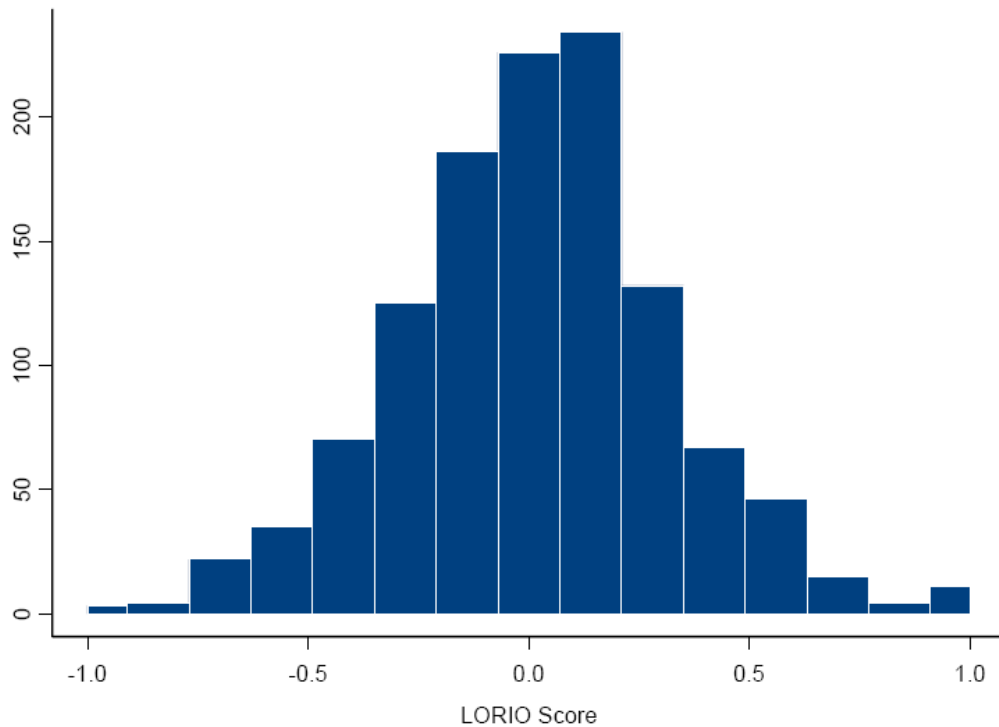

Figure 12.   Frequency of LORIO Score.

3. Sea Score

As a Surface Warfare Officer sea duty is the most important duty in one's career. Therefore, the Sea Score (SS) was calculated similar to the LORIO Score, but only including FITREPs from an officer's sea duty time. There were a total of 6610 sea duty FITREPs, representative of 1153 officers, 281 who were not offered SWOCP and 827 who were offered the bonus. There were no FITREP observations with a reporting senior cumulative average of 5.0. There were 232 observations that fell outside the interval of interest and were therefore assigned the value -1.0. The data set of 1153 officers had an average Sea Score equal to the median of 0.025. Only focusing on the sea duty FITREPs raises both the mean and median score for the data set.
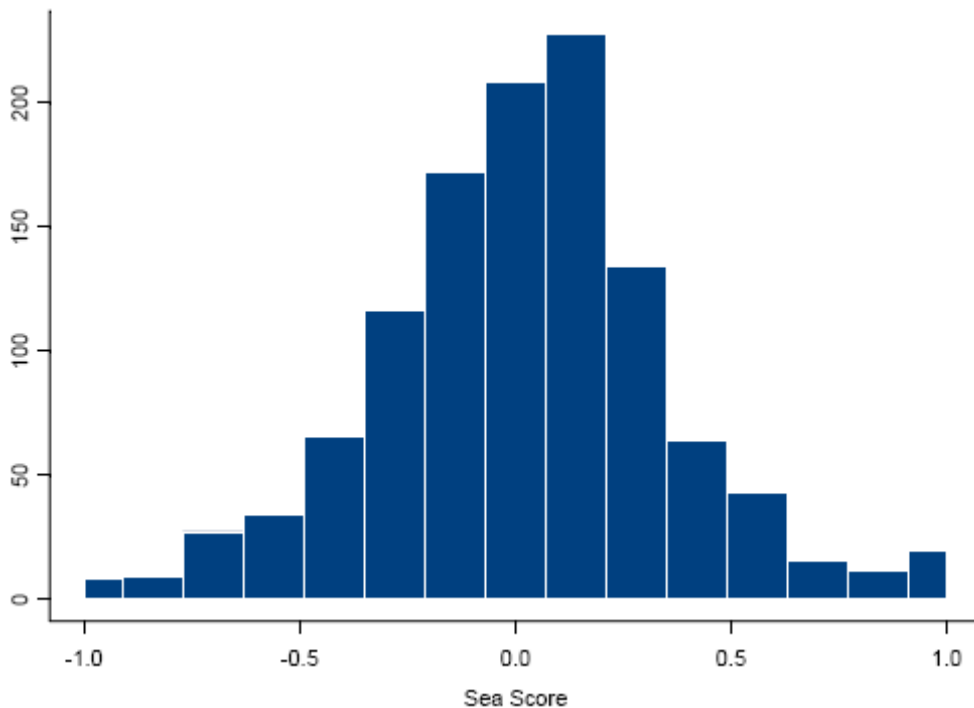
Figure 13.   Frequency of Sea Score.

4. Linear Regression

This study used multivariate logistical regression to test the significance of the difference between the two groups of data, those who were and were not offered the bonus. The analysis was based on a 95% confidence level. The response variable is LORIO Score (LS) in one case and Sea Score in another case, and the predictor variables are gender, race, commissioning source, HCI, and bonus. The levels used for race are

Caucasian, African American, American Indian/Islander, Hispanic, Other, and Unknown. The levels for commissioning source are Academy, Reserve Officers' Training Corps (ROTC), Officer Candidate (OCS), Direct Commissioning, and Unknown.   The following table enumerates the demographics of the 1180 officers in the final data set. Further demographics broken down by year group are provided in Appendix A.

Officers	Sex		Race						Comm Source				
	M	F	C	A	I	H	O	U	A	R	O	D	U
YG91-92	300	7	237	29	10	14	7	10	93	128	77	5	4
YG93-96	824	49	629	90	39	69	18	28	268	295	274	26	10
Total	1124	56	866	119	49	83	25	38	361	423	351	31	14

Race: C=Caucasian, A=African American, I=American Indian/Islander
H=Hispanic, O=Other, U=Unknown
Comm Source: A=Academy, R=ROTC, O=OCS, D=Direct, U=Unknown
Table 1.   Demographics of Final Data Set.

It is not expected that sex or race will be a significant factor in determining the quality of an officer.   Commissioning source may be a significant factor because an officer who obtains a direct commission or attends OCS may exhibit a higher quality as a result of his enlisted experience.

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V. ANALYSIS RESULTS

A. LORIO SCORE

The data set used to compute the LORIO Score (LS) consisted of 307 personnel from year groups (YG) 91 and 92 who were not offered any bonus to remain on active duty beyond their minimum service requirement (MSR) and 837 personnel from YG93-96 who accepted SWOCP to remain on active duty past their MSR. The following histogram of the LORIO Score for those not offered the bonus has an average of 0.014 and a median of 0.0. Also of note, there were ten personnel whose LS is 1.0, which means that all the FITREPs used in the calculation had an MTA of 5.0. There were also three personnel whose LS is -1.0, which means that all the FITREPs used in the calculation had an MTA equal to RSCUMAVG – (5.0 – RSCUMAVG). The histogram of the LS for those who took the bonus has an average of 0.012 and a median of 0.027. None of these observations, however, were equal to -1.0 or 1.0.
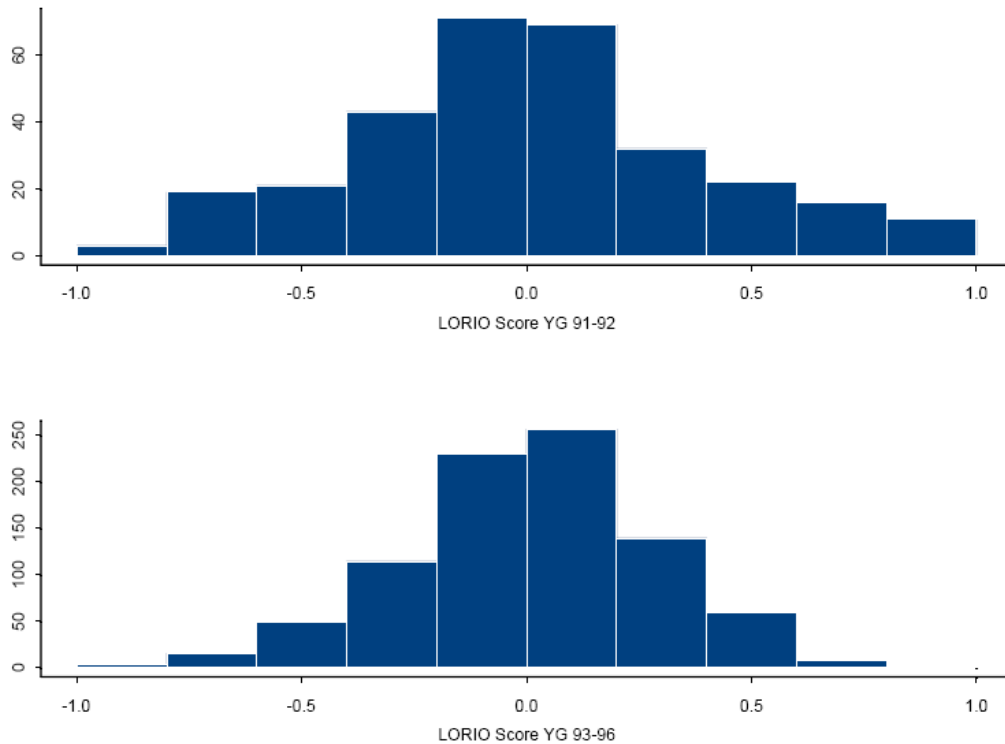

Figure 14.   LORIO Score for SWOCP 'Non-Takers' and 'Takers'.

A difference of means hypothesis test was conducted to determine if there is any significant difference between the means of the LORIO Score for 'Takers' and Non-Takers'.

$$\mu_1 \equiv \text{YG 93-96 'Takers'}$$
$$\mu_2 \equiv \text{YG 91-92 'Non-Takers'}$$
$$H_0: \mu_1 - \mu_2 = 0$$
$$H_a: \mu_1 - \mu_2 > 0$$
$$\text{p-value} = 0.4687$$

Because of the large p-value the null hypothesis is unable to be rejected, therefore there is no evidence that the 'Takers' have a higher mean LORIO Score than the 'Non-Takers'. This suggests that there is no increase in the average quality of an officer retained after implementation of SWOCP.

The base case for the linear regression model is a Caucasian male who was commissioned through the Academy. The linear regression model indicates that Bonus is not a significant factor in the quality of officers retained. The significant factors are HCI and race. While race was not expected to affect the quality of an officer, the regression suggests that Caucasians received FITREP marks that generated a higher LORIO Score than any other race in the sample.

LORIO Score ~ HCI + Sex + Race + Comm Srce + Bonus

	Coefficients:	Value	Std. Error	t value	Pr(>|t|)
	(Intercept)	-0.3187	0.0540	-5.9010	0.0000
	HCI	0.0055	0.0005	11.9340	0.0000
	Sex	0.0131	0.0398	0.3287	0.7424
R A C E	Unknown	-0.1375	0.0602	-2.2835	0.0226
	Hispanic	-0.0681	0.0335	-2.0338	0.0422
	Other	-0.0736	0.0589	-1.2508	0.2112
	Indian/Islander	-0.1177	0.0426	-2.7623	0.0058
	African American	-0.1027	0.0285	-3.5998	0.0003
C O M M S R C E	Direct	0.0646	0.0544	1.1868	0.2355
	OCS	-0.0203	0.0219	-0.9296	0.3528
	ROTC	-0.0191	0.0208	-0.9176	0.3590
	Unknown	0.0465	0.0984	0.4720	0.6370
	Bonus	0.0049	0.0193	0.2534	0.8000

Table 2.   LORIO Score Regression Results.

The R squared for this linear model, however, is 0.1422. This implies that the model accounts for 14% of the variability in the response variable, LORIO Score. Therefore, this may not be a very good model for "best fit".

B. SEA SCORE

When only sea duty FITREPs are important to the calculation of an index, the resulting scores are quite different. The mean for 'Non-Takers' is 0.027 with a median of 0.005. There were five observations with a Sea Score (SS) of -1 and 17 observations with an SS of 1.0. The data set for 'Takers' has a mean of 0.015 and a median of 0.03. Two of these observations had an SS of -1.0 and two had an SS of 1.0. This shows that there are a larger proportion of observations in the 'Non-Takers' group that are on the outer edges of the interval of interest, with most of those observations on the upper bound, meaning that they always received 5.0 marks. This explains why the average for 'Non-Takers' is higher than that of the 'Takers', yet the median is significantly lower.
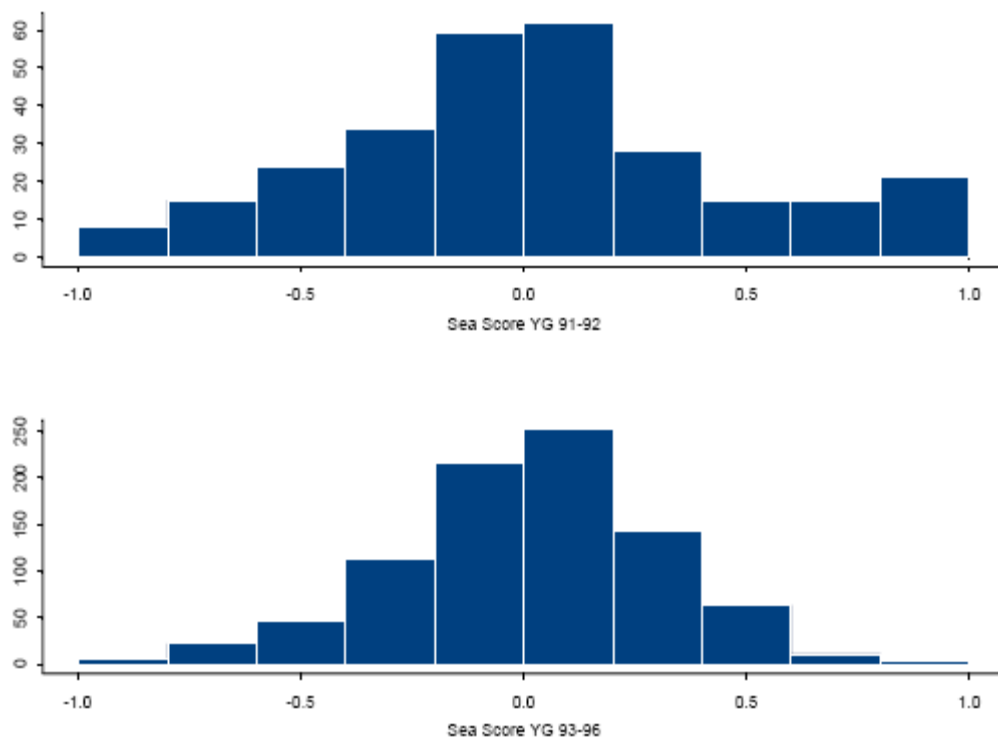

Figure 15.   Sea Score for SWOCP 'Non-Takers' and 'Takers'.

A difference of means hypothesis test was conducted to determine if there is any significant difference between the means of the Sea Score for 'Takers' and Non-Takers'.

$$\mu_1 \equiv \text{YG 93-96 'Takers'}$$
$$\mu_2 \equiv \text{YG 91-92 'Non-Takers'}$$
$$H_0: \mu_1 - \mu_2 = 0$$
$$H_a: \mu_1 - \mu_2 > 0$$
$$\text{p-value} = 0.3098$$

Because of the large p-value the null hypothesis is unable to be rejected, therefore there is no evidence that the 'Takers' have a higher mean Sea Score than the 'Non-Takers'. This suggests that there is no increase in the average quality of an officer retained after implementation of SWOCP.

The base case for the linear regression model is a Caucasian male who was commissioned through the Academy. The linear regression model used to test the significance of the bonus as a predictor variable for Sea Score shows that the bonus is not a significant factor in retaining better quality officers. The significant factors in the linear model are HCI and race. Again, Caucasians received FITREP marks that resulted in a higher Sea Score, on average, than other races in the sample.

Sea Score ~ HCI + Sex + Race + Comm Srce + Bonus

	Coefficients:	Value	Std. Error	t value	Pr(>|t|)
	(Intercept)	-0.3378	0.0598	-5.6492	0.0000
	HCI	0.0058	0.0005	11.2574	0.0000
	Sex	0.0361	0.0437	0.8257	0.4091
R A C E	Unknown	-0.1811	0.0676	-2.6803	0.0075
	Hispanic	-0.0709	0.0370	-1.9141	0.0559
	Other	-0.0703	0.0647	-1.0861	0.2776
	Indian/Islander	-0.1311	0.0468	-2.7994	0.0052
	African American	-0.1288	0.0317	-4.0590	0.0001
C O M M S R C E	Direct	0.0552	0.0598	0.9232	0.3561
	OCS	-0.0250	0.0243	-1.0282	0.3041
	ROTC	-0.0242	0.0231	-1.0471	0.2953
	Unknown	0.0646	0.1115	0.5793	0.5625
	Bonus	-0.0037	0.0220	-0.1665	0.8678

Table 3.   Sea Score Regression Results.

The linear model does not appear to be a very good predictor of the actual values, however. R squared for the model is 0.1374, which indicates that approximately 13% of

the variability of the Sea Score is captured by this model. This suggests that perhaps the predictor variables are not particularly useful in determining an individual's Sea Score.

C.   HCI

Since the Human Capital Index (HCI) is calculated using an entire cohort of a specific rank and designator, this was not a useful measure to compare the quality of officers at a particular point in their career. HCI, however, can be used to compare the cohort of LCDRs designated 1110 from year groups 91-95, some of which accepted SWOCP. The data set of interest for this analysis contains 832 officers, 308 who were not offered a bonus and 524 who accepted the bonus. There is hardly any difference in the mean or median of the data when broken into SWOCP 'Non-Takers' and 'Takers'. For YG 91-92 the mean HCI is 65.06 and the median is 66.88, whereas YG93-95 has a mean HCI of 65.71 with a median of 65.42.
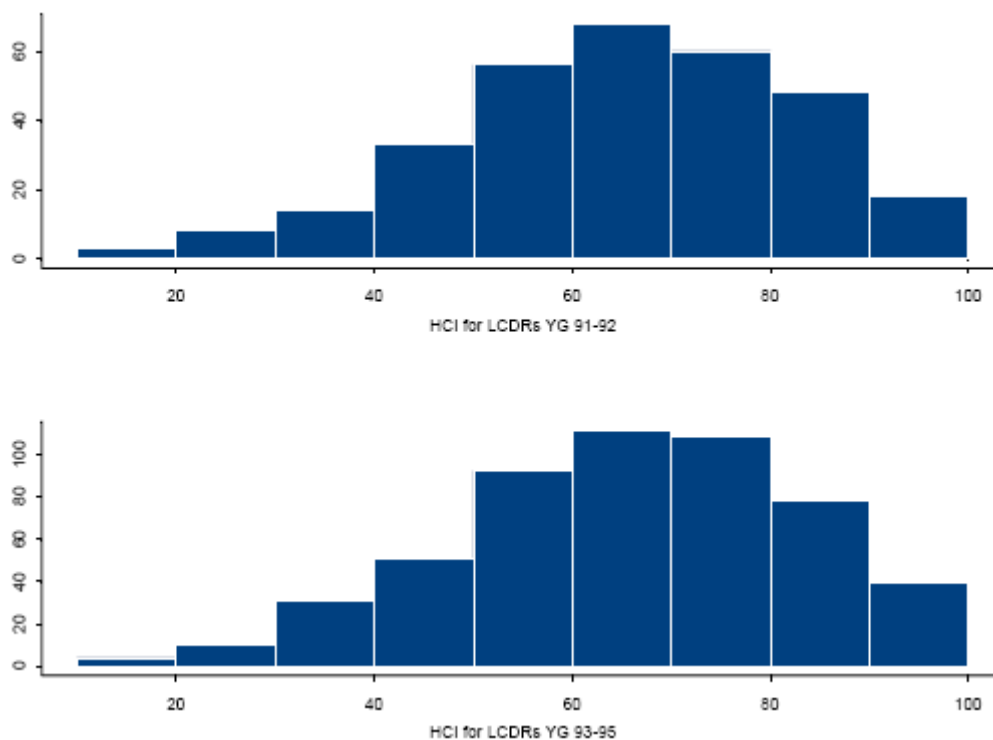

Figure 16.   HCI for LCDR SWOCP 'Non-Takers' and 'Takers'.

A difference of means hypothesis test was conducted to determine if there is any significant difference between those LCDRs who have taken the bonus and those who were not offered the bonus.

$$\mu_1 \equiv \text{YG 93-95 'Takers'}$$
$$\mu_2 \equiv \text{YG 90-92 'Non-Takers'}$$
$$H_0: \mu_1 - \mu_2 = 0$$
$$H_a: \mu_1 - \mu_2 > 0$$
$$\text{p-value} = 0.6977$$

Because of the large p-value the null hypothesis is unable to be rejected, therefore there is no evidence that the 'Takers' have a higher mean HCI than the 'Non-Takers'. This suggests that there is no increase in the average quality of an officer retained after implementation of SWOCP.

VI.   CONCLUSIONS AND RECOMMENDATIONS

A.   CONCLUSIONS

Surface Warfare Officer Continuation Pay (SWOCP) was introduced to increase retention, alleviate manning shortages for department head billets, and improve the ability to attract and retain high-quality officers in the SWO community. The first two goals are easily measured by looking at the total number of officers retained, however there is a need for a reasonable measure of quality to determine whether or not the goal of retaining high-quality officers is being achieved. The Human Capital Index (HCI) has been suggested as a quantitative measure of quality. The algorithm used for calculating HCI was not made available, so there was no way to verify the statistical validity of this index. Even if the formula had been made available, there is no way to create an HCI for an individual unless the data is available for the entire population of individuals of the same rank and designation. This study suggests the LORIO and Sea Scores as reasonable measures of quality for an individual.   The derivation of the algorithms has been presented to validate this suggestion. These scores can be calculated for any sample size so long as there is fitness report data available for all the individuals in the sample. There is very little correlation between the LORIO Score and HCI and the Sea Score and HCI, however. Only 12% of the variance is in common for the LORIO Score and HCI, and only 11% of the variance is in common for the Sea Score and HCI. It is obvious that quality is a hard concept to measure quantitatively, yet this study made use of the LORIO and Sea Scores to present statistical analysis of the quality of retention.

While SWOCP has been effective in retaining the desired number of personnel to fill DH billets, there is no statistical evidence from the data analyzed that the bonus has any affect in retaining better (or worse) quality officers when that quality is measured at a decision point of YCS6. There is also no statistical evidence to suggest that the bonus has any significant influence on the downstream performance of officers. There is no indication of a propensity for officers who accepted the bonus to be better quality officers than those who were retained before the bonus was introduced. These observations may result from the fact that the number of officers retained is still below VADM Hoewing's goal of 38% for selectivity in detailing.

An interesting factor that was not expected to influence a quality score for an individual was race. Race, however, showed evidence of influencing both the predicted LORIO Score and Sea Score for an individual. This finding leads to a need to strive for quality over diversity when targeting groups for retention.

This study was limited by the sample size of officers who had both FITREPs and HCI available. While approximately 95% of the officers had an HCI, only approximately 70% had FITREP data available. Another limitation was encountered as a result of being unable to obtain the algorithm to compute HCI. It is unclear whether or not any weighting is considered in the calculation. It should also be noted that HCI may not be the most useful means for determining the quality of a SWO since, in reality, performance at sea is more crucial than performance ashore.

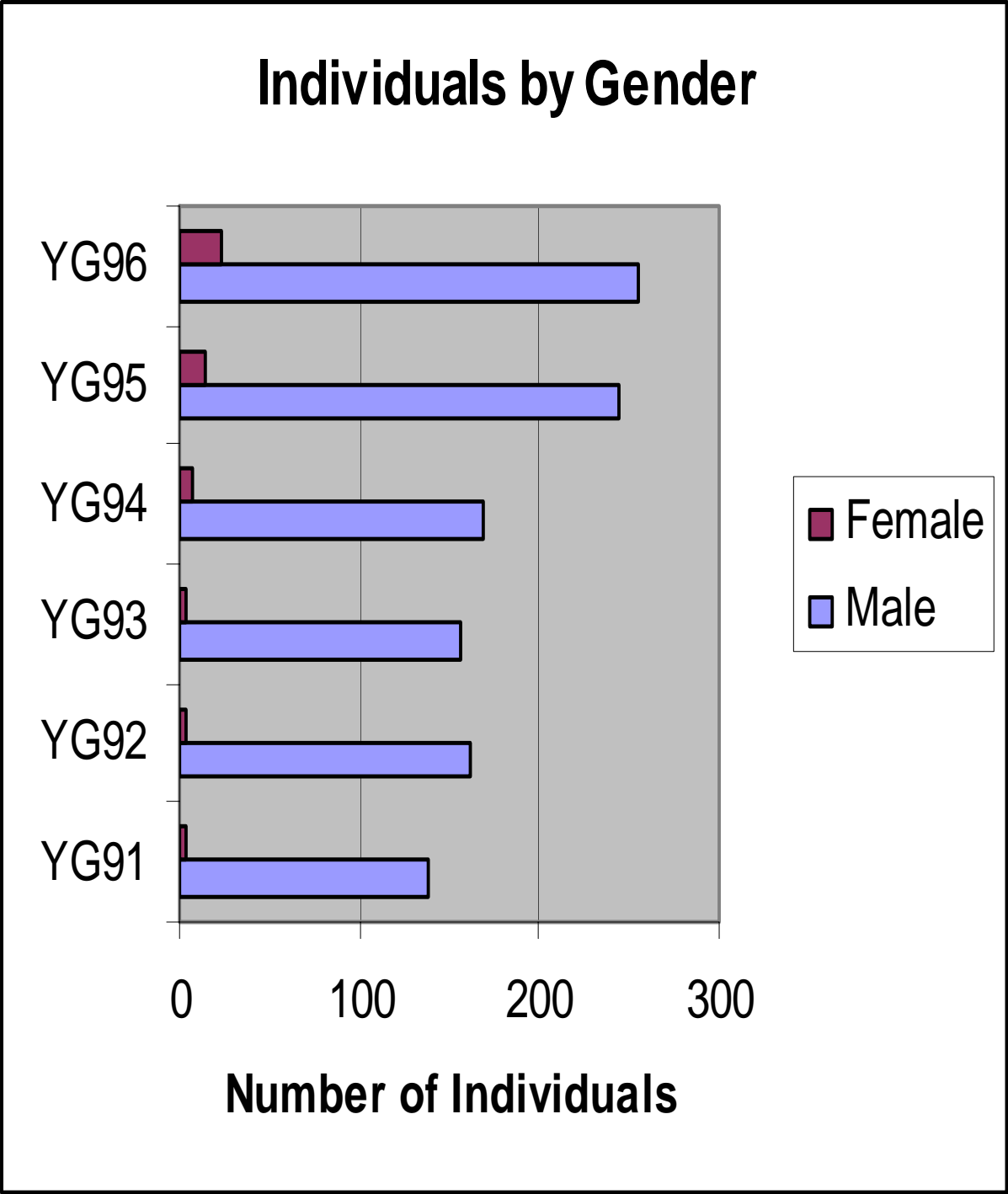## B.   RECOMMENDATIONS AND CONSIDERATIONS FOR FURTHER RESEARCH

Since the current policy for offering SWOCP is necessary to retain officers for DH billets, yet there is no evidence of a higher-quality officer being retained, it may be time to reevaluate the method of offering the bonus. SWOCP is primarily a retention tool, but should more officers be retained than desired, the bonus may be used more judiciously to attract more quality officer retention. It may be useful in the future to determine a threshold dollar amount for which high-quality officers with a propensity to depart the Navy would choose to remain on active duty. This information could be used to develop a graduated method of offering the bonus, in which an officer is offered a dollar amount commensurate with his quality as a junior officer. Better data is needed to conduct a more thorough analysis of the effects of SWOCP on retention of quality officers.

This analysis showed that as an individual become more senior within a rank he generally receives a higher Member Trait Average (MTA). It may be useful to examine if there are similar trends in a Reporting Senior Cumulative Average (RSCUMAVG). For example, does an individual's RSCUMAVG increase as the individual becomes more senior?
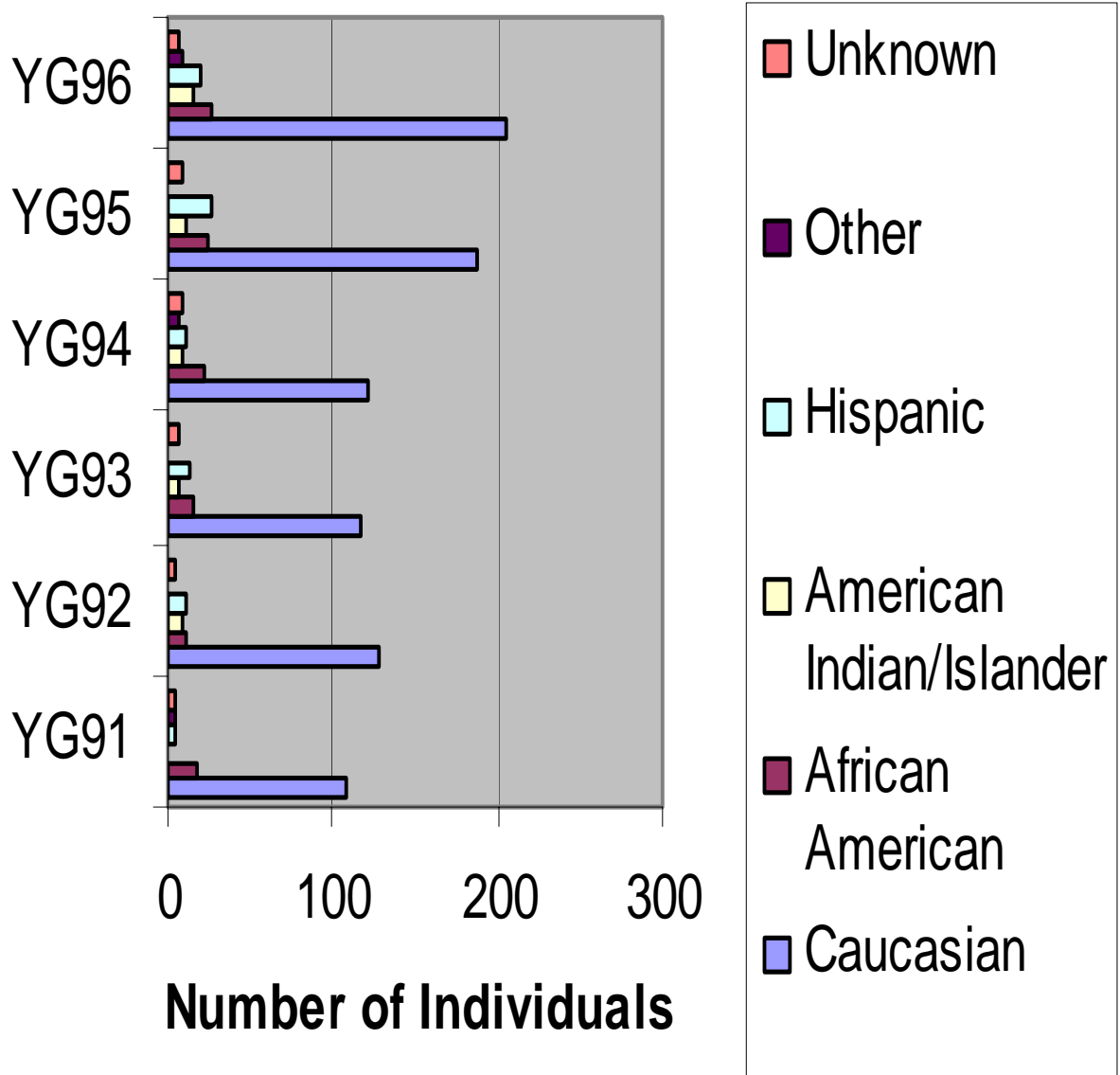
The MTA$_{adjusted}$ developed for this study is a useful measure for comparing officers quantitatively. This measure should be used by BUPERS on promotion boards to more easily display an individual's quality. MTA$_{adjusted}$ gives a clear representation of where an officer falls out in relation to others and serves as a leveler among the different RSCUMAVGs. A board member will be able to more easily see if an officer is above or below the pack of officers being considered for promotion.

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Individuals by Race

Legend:
- Unknown
- Other
- Hispanic
- American Indian/Islander
- African American
- Caucasian

Y-axis categories: YG96, YG95, YG94, YG93, YG92, YG91

X-axis: Number of Individuals (0, 100, 200, 300)

Individuals by Commissioning Source

Legend:
- Unknown
- Direct Comm
- ROTC
- OCS
- Academy

Categories (vertical axis): YG96, YG95, YG94, YG93, YG92, YG91

Number of Individuals (horizontal axis): 0, 50, 100, 150
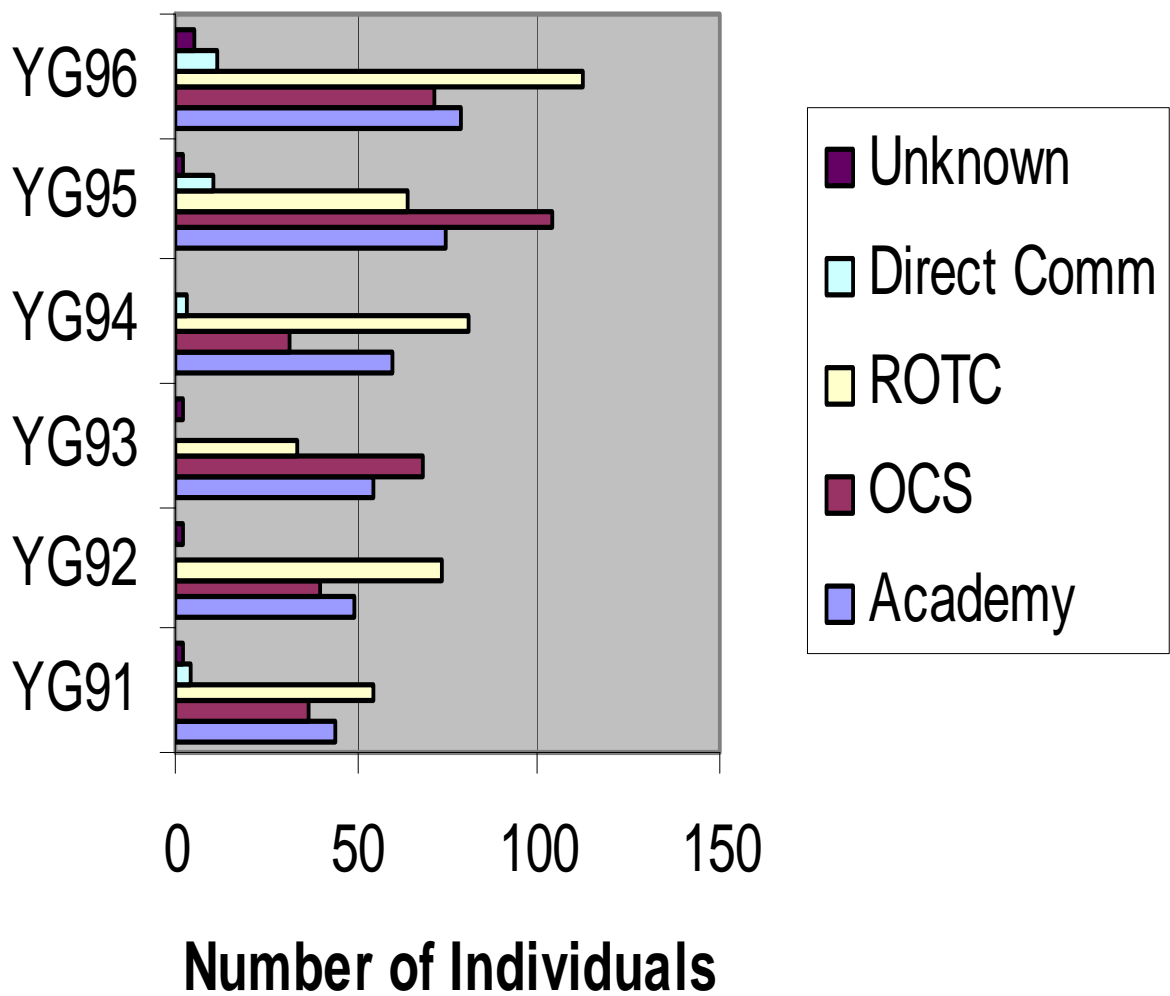
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